Pricing Policies And Control of Tobacco in Europe (PPACTE) project: Cross-national comparison of smoking prevalence in 18 European countries

Silvano GALLUS[1]*, Alessandra LUGO[2], Carlo LA VECCHIA[1,2], Paolo BOFFETTA[3,4], Frank J CHALOUPKA[5], Paolo COLOMBO[6], Laura CURRIE[7,8], Esteve FERNANDEZ[9,10,11], Colin FISCHBACHER[12], Anna GILMORE[13], Fiona GODFREY[14], Luk JOOSSENS[15], Maria E LEON[16], David T LEVY[17], Lien NGUYEN[18], Gunnar ROSENQVIST[18,19], Hana ROSS[20], Joy TOWNSEND[21], Luke CLANCY[8]

(1) Department of Epidemiology, IRCCS - Istituto di Ricerche Farmacologiche "Mario Negri", Milan, Italy
(2) Department of Clinical Sciences and Community Health, Università degli Studi di Milano, Milan, Italy
(3) Institute for Translational Epidemiology and Tisch Cancer Institute, Ichan School of Medicine at Mount Sinai, New York, NY, USA
(4) International Prevention Research Institute, Lyon, France
(5) Department of Economics, University of Illinois at Chicago, Chicago, IL, 60174, USA
(6) Istituto DOXA, Worldwide Independent Network/Gallup International Association (WIN/GIA), Milan, Italy
(7) Division of Population Health Science, Royal College of Surgeons in Ireland, Dublin, Ireland
(8) TobaccoFree Research Institute Ireland, Dublin, Ireland
(9) Tobacco Control Unit, Cancer Prevention and Control Program, Institut Català d'Oncologia – ICO, L'Hospitalet de Llobregat (Barcelona) Spain
(10) Cancer Control and Prevention Group, Institut d'Investigació Biomèdica de Bellvitge-IDIBELL, L'Hospitalet de Llobregat (Barcelona), Spain
(11) Department of Clinical Sciences, Universitat de Barcelona, Barcelona, Spain
(12) Information Services Division, NHS National Services, Edinburgh, Scotland
(13) Department for Health, University of Bath, Bath BA2 5AX, UK
(14) Independent legal consultant in public health. Luxembourg.
(15) Association of the European Cancer Leagues & Foundation Against Cancer, Brussels, Belgium
(16) Section of Environment and Radiation, International Agency for Research on Cancer, Lyon 69008, France
(17) Lombardi Comprehensive Cancer Center, Department of Oncology, Georgetown University, 3300 Whitehaven Street NW, suite 4100, Washington, DC 20007
(18) Centre for Health and Social Economics – CHESS, National Institute for Health and Welfare (THL), Helsinki, 00270, Finland
(19) Department of Finance and Statistics, Hanken School of Economics, Helsinki, 00101, Finland
(20) Intramural Research Department, American Cancer Society, Atlanta, GA 30303, USA
(21) Department of Social and Environmental Health Research, London School of

Hygiene and Tropical Medicine, London WC1H 9SH, UK

Keywords cross-sectional survey; smoking prevalence; Europe.

Word count Abstract 235; main text 3422

Correspondence to:
Carlo La Vecchia, MD
Department of Epidemiology
IRCCS - Istituto di Ricerche Farmacologiche “Mario Negri”
Via Giuseppe La Masa 19, 20156 Milano
tel: +390239014527 – fax: +390233200231
e-mail: carlo.lavecchia@marionegri.it

European Journal of Cancer Prevention, 29 August 2013

ABSTRACT

Objective Limited data on smoking prevalence allowing valid between-country comparison are available in Europe. The aim of this study is to provide smoking prevalence and its determinants in 18 European countries.

Methods In 2010, within the Pricing Policies and Control of Tobacco in Europe (PPACTE) project, we conducted a face-to-face survey on smoking in 18 European countries (Albania, Austria, Bulgaria, Czech Republic, Croatia, England, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Poland, Portugal, Romania, Spain and Sweden), on a total of 18,056 participants, representative for each country of the population aged ≥15 years.

Results Overall, 27.2% of participants were current smokers (30.6% of men and 24.1% of women). Smoking prevalence was highest in Bulgaria (40.9%) and Greece (38.9%) and lowest in Italy (22.0%) and Sweden (16.3%). Smoking prevalence for men ranged between 15.7% (Sweden) and 44.3% (Bulgaria), and for women between 11.6% (Albania) and 38.1% (Ireland). Multivariate analysis showed a significant inverse trend between smoking prevalence and the level of education in both sexes. Male-to-female smoking prevalence ratios ranged from 0.85 in Spain to 3.47 in Albania, and current-to-ex prevalence ratios from 0.68 in Sweden to 4.28 in Albania.

Conclusions There are substantial differences across Europe in smoking prevalence, and male-to-female and current-to-ex smoking prevalence ratios. Eastern European countries, lower income countries and those with less advanced tobacco control policies have less favourable smoking patterns and are at an earlier stage of the tobacco epidemic.

INTRODUCTION

According to the World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC),[1] population-based national and international monitoring data are crucial to effectively plan and implement country-specific and regional strategies to reduce tobacco use and harm. Despite this, a large proportion of the European population is still not covered by reliable data on smoking prevalence. In fact, fewer than half of the European Union (EU) Member States (MS) measure smoking prevalence through national surveys on an annual or biennial basis.[2, 3] Moreover, comparisons between European countries are difficult, since national surveys on tobacco are heterogeneous in terms of: i) sampling methodology (representative *vs* non representative; quota sampling *vs* multi-stage random sampling; household *vs* individual surveys); ii) study design (general surveys *vs* surveys specifically focusing on tobacco use; face-to-face *vs* telephone *vs* mail or internet-based interview); iii) population focus (overall population *vs* specific age-sex groups); iv) response rate; v) sample size (differing by up to three orders of magnitude); and vi) definition of smoking status (phrasing of question used to define smoking; tobacco product considered; lifetime *vs* current smokers). Consequently, even for the same calendar period and country, substantial discrepancies are apparent in terms of smoking prevalence using different datasets.[4, 5] This underlines the need for cross-national comparisons of data on tobacco use from different surveys conducted with different methodologies [6, 7] to be interpreted cautiously.[2, 5]

Data from representative surveys on adults conducted in more than one European country during the same calendar period, using a uniform and standard methodology, are limited to a few studies,[8-16] including the WHO's Global Adult Tobacco Survey (GATS),[16] and the EU's Eurobarometer.[17-19]

The GATS is a nationally representative household computer assisted personal interview (CAPI) survey, launched by WHO and the US Centers for Disease Control and Prevention (CDC) in 2007, using a comprehensive standard core questionnaire and consistent methodology, including sample design, data collection and data management. To date, GATS has been implemented in 14 of the 16 initially planned low- and middle-income countries, including 4 European ones (Poland, the Russian Federation, Turkey and Ukraine).[16] Thus, although GATS is well-designed and conducted, cross-national

comparisons between European countries are limited.

The Eurobarometer, a periodical survey commissioned by the European Commission and conducted in all the EU MS plus a few additional non-EU countries, has on several occasions since 1990 included a section on attitudes towards tobacco. In 2006, 2009 and 2012, Eurobarometer conducted CAPI surveys showing that the average smoking prevalence across the EU MS and in both sexes combined decreased from 32% in 2006 to 29% in 2009 and 28% in 2012, with substantial differences between various MS.[17-19] The utility of Eurobarometer data for tobacco surveillance is, however, limited by the lack of breakdowns within country by sex, age and socio-economic characteristics in the result reports.[2]

Pricing Policies and Control of Tobacco in Europe (PPACTE) is a project aiming to provide the most comprehensive analysis of the effectiveness of tobacco fiscal policy in Europe (www.ppacte.eu).[20-22] Within the PPACTE project, a survey was conducted in 18 selected European countries, in order to fill the gaps in available data on smoking with a specific focus on economic aspects of smoking, providing cross-national comparisons[20, 21, 23] which will be of invaluable aid in supporting future tobacco control and research in Europe.

METHODS

The PPACTE survey

Data were derived from a face-to-face survey conducted between January and July 2010 in 18 selected European countries (Albania, Austria, Bulgaria, Czech Republic, Croatia, England, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Poland, Portugal, Romania, Spain and Sweden) using standardized methods.[4] The survey was coordinated by DOXA, the Italian branch of the GALLUP International Association, and conducted by its European partners.[20, 21, 23]

The survey included a total of 18,056 individuals (8653 men and 9403 women) aged 15 years and older (other than Croatia, England, Finland, Greece, Hungary and Poland where the sample was aged ≥18 years), representative of the general population in terms of age, sex, geographical area and socio-economic characteristics for each of the 18 participating countries. Therefore, this survey is representative of 311 million

inhabitants aged 15 or over from 18 European countries. The sample size was around 1000 participants for each country. The 18 European countries were selected in order to include countries with inadequate data on smoking and also those with valid data, so that data from the latter could be used as a reference point to standardize findings from the former. Among the countries with complete data, we prioritized those with full or partial smoking-bans in all workplaces in 2010 (Finland, France, Ireland, Italy, Spain and the UK) and those that systematically increased prices of tobacco products over the last few years (France, Ireland, Portugal, Spain and the UK). Among countries with inadequate data, we focused on the newest EU MS (Romania and Bulgaria) and one candidate country (Croatia). In addition, Latvia and Albania were selected because of their reportedly high prevalence of cigarette tax evasion/avoidance. Other countries, including Finland and in particular Sweden were selected for their frequent use of smokeless tobacco (Swedish snus).

Table 1 provides information on survey characteristics for each country, including fieldwork dates, sample size, age range and sampling method. In several countries (Albania, Croatia, Hungary, Italy, Poland and Romania) a multi-stage methodology was used. In the first stage, the primary unit of selection was a geographic area or voting centre. In the second stage, households or municipalities were selected. In the last stage, respondents were chosen randomly, in order to be representative of the population in terms of sex, age, geographic area and socio-economic characteristics (working status, occupation and income). In those countries where adult respondents had been selected from electoral rolls, the quota method was used to select respondents aged 15 to 17. For other countries (Austria, England, Finland, France and Ireland) we used a quota method for the selection of the entire sample, stratifying the population according to selected variables including age, sex, and alternatively geographic area and/or occupation, in order to obtain a representative sample of the country population. For other countries, we used other sampling methodologies, including a stratified random method for Bulgaria, the Czech Republic and Latvia, or a simple random method for Greece. Given the different sampling methodologies used, various surveys had heterogeneous response rates. Full details of the survey methodology and response rates are reported elsewhere.[21]

Variables

We developed a standardized questionnaire (i.e., the European Survey Tool), which was piloted in Italy and subsequently translated into various languages. Besides information on socio-demographic characteristics, data on smoking behaviour, including smoking status and age of uptake, were collected. Current smokers were defined as those who had smoked 100 or more cigarettes (including manufactured and hand-rolled cigarettes) in their lifetime and smoked when the survey took place. Ex-smokers were defined as who had smoked 100 or more cigarettes in their lifetime, but did not smoke at the time the survey took place.

Education was categorized in three levels (low/intermediate/high) by DOXA and its European partners, according to the country-specific school system. One additional question of the European Survey Tool asked for the years or level of education. This allowed us to check for the accuracy and thus validate the education classified in three levels. With reference to geographic area, countries were categorized in Northern (England, Finland, Ireland, Sweden), Western (Austria, France), Southern (Greece, Italy, Portugal, Spain) and Central/Eastern Europe (Albania, Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Poland, Romania). For each country, Gross Domestic Product (GDP) per capita adjusted for Purchasing Power Parity (PPP) in 2010 in euro (€), was obtained from International Monetary Fund (IMF) databases.[24] Using this variable, countries were then categorized into two groups based on GDP per capita <16,000€ (Albania, Bulgaria, Croatia, Hungary, Latvia, Poland, Romania) and GDP ≥16,000€ (Austria, Czech Republic, England, Finland, France, Greece, Ireland, Italy, Portugal, Spain, Sweden). For the EU MS, the Tobacco Control Scale (TCS) scores, updated to 2010,[25] were used to distinguish countries with limited implementation of tobacco control policies (TCS <45; Austria, Bulgaria, Czech Republic, Greece, Hungary, Latvia, Poland, Portugal) from those with a better implementation (TCS ≥45; England, Finland, France, Ireland, Italy, Romania, Spain, Sweden). Albania and Croatia, not EU MS, were excluded from the TCS stratification analyses.

Ethics

The study protocol was approved by the Institutional Review Board of the Istituto di Ricerche Farmacologiche “Mario Negri”. The procedures for recruitment of subjects,

informed consent, data collection, storage and protection (based on anonymous identification code) are in accordance with the current country specific legislation. This was ratified and signed by DOXA and each of its European partners.

Statistical analysis

For each country, statistical weights were used to generate estimates representative of various country populations. To calculate results for the whole sample of countries, we applied a weighting factor, with each country contributing in proportion to its population aged 15 years or over, obtained by Eurostat.[26]

In the present paper, we consider descriptive statistics, including relative frequency (%) and corresponding 95% confidence intervals (CI) for categorical variables, and mean and standard deviation (SD) for continuous variables. For each country and for selected variables, we computed the male-to-female smoking prevalence ratio (M/F) and the current-to-ex smoking prevalence ratio (C/E). M/F is the ratio between the prevalence of current smokers among men and that among women; C/E is the ratio between the prevalence of current smokers and that of ex-smokers and was computed for the overall population and by sex. Those two measures were taken as a mark of the evolution of the tobacco epidemic.[27-29]

Odds ratios (OR), and corresponding 95% CI, for current smokers *vs* non smokers (never and ex-smokers combined) for individual-level characteristics were estimated using multilevel (two-levels) logistic random effects models (random intercept) in order to take into account the heterogeneity between the 18 European countries. The study country effects were considered as random, and age and level of education as adjusting variables. ORs and 95% CIs for country specific characteristics were estimated by unconditional multiple logistic regression models, including terms for age and level of education. ORs for the overall population were further adjusted for sex. The analyses were conducted using the GLIMMIX procedure in SAS 9.2 (SAS Institute).

We used the Pearson's-correlation coefficients (r) to analyze the relation between selected smoking characteristics from the PPACTE survey (i.e., prevalence of current smokers, M/F and C/E) and the PPP adjusted GDP, the TCS score and smoking characteristics obtained from the 2009 Eurobarometer survey (i.e., prevalence of current smokers, and C/E).[18]

RESULTS

Table 2 provides country-specific smoking prevalence estimates for the study population, overall and by sex, the M/F and the C/E. Smoking prevalence by country is also shown in Figure 1. Overall, 56.8% (95% CI: 56.1%-57.5%) of 18,056 participants described themselves as never smokers (49.5% of men and 63.6% of women), 16.0% (95% CI: 15.5%-16.5%) as ex-smokers (19.9% of men and 12.3% of women) and 27.2% (95% CI: 26.6%-27.8%) as current smokers (30.6% of men and 24.1% of women). The overall M/F was 1.27 and the overall C/E was 1.70 (1.53 among men and 1.96 among women).

The highest estimates of current smoking prevalence were observed in Bulgaria (40.9%) and Greece (38.9%) and the lowest estimates were in Sweden (16.3%) and in Italy (22.0%). Smoking prevalence for men ranged between 15.7% (Sweden) and 44.3% (Bulgaria), and that for women between 11.6% (Albania) and 38.1% (Ireland). The M/F was highest in Albania (3.47) and in Latvia (2.63). In Sweden (0.92), Ireland (0.89) and Spain (0.85) smoking prevalence of women exceeded that of men. The C/E was highest in Albania (4.28) and in Hungary (3.87). In Finland (0.96) and Sweden (0.68) the prevalence of ex-smokers exceeded that of current smokers.

Among current smokers, mean (SD) age at starting smoking regularly was 17.8 (4.4) years overall, 17.4 (3.7) years among male and 18.2 (5.2) years among female smokers, and ranged between 16.0 (1.6) years in Ireland and 19.4 (6.2) years in Romania; 85.0% of European current smokers started smoking between 12 and 20 years of age, and 95.8% before 25 years of age.

Table 3 provides smoking prevalence estimates for the study population, overall and by sex, the M/F and the C/E, according to selected individual-level and country specific characteristics. For both sexes, the highest smoking prevalence was reported among the 25-44 year age group (39.8% in males and 32.0% in females), and the lowest among the elderly (15.3% in males and 8.6% in females). Smoking prevalence among the young (<25 years) was higher in women (27.0%) than in men (26.0%), and in most countries was lower than that for older adults (25-64 years). Some exceptions were found for both sexes in Finland (42.9% in boys and 28.3% in girls), Hungary (49.3% in

boys and 34.8% in girls) and Sweden (21.5% in boys and 26.7% in girls). For women, in Albania (18.5%), England (29.4%) and Portugal (38.4%), the young showed the highest smoking rates as compared to all other age groups. In all age groups older than 25 years, men were more frequently current smokers than women, with the M/F increasing with age (0.96 for <25, 1.24 for 25-44, 1.27 for 45-64 and 1.78 for ≥65 years). C/E decreased with increasing age (5.10 for <25, 3.06 for 25-44, 1.27 for 45-64 and 0.49 for ≥65 years).

The prevalence of current smokers was highest in subjects with an intermediate level of education overall (29.6%), in men (31.5%) and in women (27.8%). M/F was highest in subjects with a lower level of education (1.50) and C/E was highest in those with an intermediate level of education (1.89).

M/F was higher in Eastern European countries (1.56) as compared to Western (1.30), Southern (1.13) and Northern European countries (1.13), and in countries with per capita GDP adjusted for PPP <16,000€ (1.56) than in countries with higher GDP (1.19). M/F was higher in countries with limited implementation of tobacco control activities (TCS <45; 1.40) as compared to those with high implementation (TCS ≥45; 1.20). C/E was higher in Eastern European countries (2.80) as compared to Western (1.40), Southern (1.93) and Northern European countries (1.03), in countries with lower GDP (2.86) than in countries with higher GDP (1.49) and in countries with limited implementation of tobacco control activities (2.85) as compared to those with high implementation (1.42).

Table 4 shows the ORs for current smokers *vs* non smokers (never and former combined) according to selected individual-level and country specific characteristics, overall and by sex. Compared with men, the OR for women was 0.73. Multivariate analysis confirmed that middle aged subjects were more frequently current smokers than the young and the elderly (as compared to <25, ORs were 1.65 for 25-44, 1.05 for 45-64 and 0.37 for ≥65 years). A significant inverse trend was found in both sexes with level of education (ORs for low *vs* high level of education were 1.50 overall, 1.62 for men and 1.37 for women). Compared with Northern Europe, ORs were 1.16 in Western, 1.05 in Southern and 1.18 in Eastern and Central European countries. The corresponding estimates for men were 1.27 in Western, 1.04 in Southern and 1.46 in Eastern and Central European countries. No differences according to geographic area

were observed for women. Overall, smoking prevalence was significantly higher in countries with a relatively low per capita GDP (ORs were 1.08 overall, 1.30 for men and 0.86 for women) and with low tobacco control activities (OR were 1.27 overall, 1.44 for men and 1.10 for women).

DISCUSSION

In the present survey, one of the few European studies on smoking in adults allowing for between-country comparisons, we found substantial differences in terms of smoking characteristics across European countries. Smoking prevalence in 2010 was 27% overall (31% in men and 24% in women) and ranged between 16% in Sweden and 41% in Bulgaria. Substantial differences were also observed by gender and the ratio of current to former smoking.

Only about 10% of European smokers started smoking after 20 years of age. Although a possible cohort effect could not be ruled out (adolescents today might have different patterns of tobacco use, including age at starting smoking, than participants included in the present survey), we confirm that teen-agers represent the most important target population for interventions against smoking initiation. These interventions should be targeted to both boys and girls, since smoking prevalence among the young (before 25 years of age) is similar between sexes. Smoking prevalence among the young differed substantially across the study countries, being in Italy and the Czech Republic approximately half relative to Hungary and Bulgaria. These estimates are however based on a limited number of subjects (overall, 1430 boys and 1430 girls), and should therefore be interpreted with caution. In general, younger subjects smoke less frequently than older adults and certainly much less than previous generations around age 20.[30] However, in selected countries, including Finland, Hungary and Sweden in both sexes, and Albania, England and Portugal in women, smoking prevalence among the young alarmingly exceeded that of all other age groups.

Multivariate analysis shows that the level of education, used as a proxy of socio-economic status, is inversely related to smoking prevalence, not only in men but also in women. This confirms findings from recent studies conducted in Europe[31-33] and other high income countries, including the USA,[34] suggesting that in Europe

education is a strong predictor of smoking in both sexes. Hence, less educated individuals should be a key-target population for interventions aiming to prevent addiction to smoking.[33]

Per capita GDP was inversely correlated with prevalence of current smokers (r=-0.20; p=0.431), M/F (r=-0.62; p=0.006) and C/E (r=-0.64; p=0.004). The TCS score was also inversely correlated with smoking prevalence (r=-0.32; p=0.220), M/F (r=-0.32; p=0.231) and C/E (r= -0.60; p = 0.015). Consequently, lower income countries and those with less strict tobacco control activities, mainly from Eastern Europe, had less favourable smoking patterns.[35] According to the model of the tobacco epidemic,[28, 29] countries with higher smoking prevalence, male to female prevalence ratio and current to former smoking prevalence ratio are in a relatively early stage, and those with low levels are in a more advanced stage.[27-29] Therefore, whereas Eastern European countries appear to be in a less advanced, Northern European countries, and to a lesser extent, Southern and Western Europe, appear to be in a more advanced stage of the tobacco epidemic.[28, 29, 36] These findings are confirmed by the trends in lung cancer incidence and mortality over the last decade in various European countries.[37, 38] Consequently, effective interventions to control tobacco should be planned and implemented according to these country-specific tobacco characteristics.[28, 29] In particular, countries in the earliest stage of the tobacco epidemic should concentrate tobacco control interventions, besides smoking cessation, on smoking initiation in women. On the contrary, in countries in the last stage of the tobacco epidemic, tobacco control interventions should converge on smoking cessation for both sexes.[28, 29]

Overall smoking prevalence was higher in countries with a low tobacco control activity. This has been observed in men but not in women, suggesting that tobacco control programs pay insufficient attention to women.

The limitations of the present study include some differences of sampling methodology used in the study countries. In addition, the age range of participants was slightly different in some countries, with those aged 15-18 years excluded in six of the 18 countries. However, considering age-adjusted smoking prevalence estimates by country, the results did not considerably change. Moreover, the differences in age range were substantial only for the Greek sample, which was limited to 18-64 years. However, our findings from Greece are in broad agreement with those found in the 2009

Eurobarometer survey.[18] Strengths of our survey include the representativeness of the adult population of 18 strategically selected European countries, the European Survey Tool (questionnaire) agreed by a core of tobacco control experts and administered in the 18 countries sampled, the standardized use of a single definition of current smokers and the use of face-to-face interview. Our survey provides prevalence estimates by sex and age group for each country as well as by educational level, demographic attributes known to modulate tobacco demand. Thus our study generates data of great value for descriptive and interventional purposes in public health and policy context.

Our results were consistent with those from the Eurobarometer survey conducted in 2009.[18] The prevalence of current smokers ($r=0.73$; $p=0.001$), that of former smokers ($r=0.75$; $p=0.001$) and the C/E ($r=0.75$; $p=0.001$) obtained from this European survey and the corresponding measures from the Eurobarometer survey were highly correlated.

In conclusion, our data represent an important and reliable tool to define future efficient intervention strategies to control tobacco and their target sub-populations in various European countries.

Acknowledgements We thank Dr Irene Tramacere for her valuable help in the finalization of the survey questionnaire.

Collaborators Irene Tramacere.

Contributors SG, CLV and LCl had the original idea for the study; all authors contributed to the finalization of the survey questionnaire; PC and SG provided data from the survey; AL conducted the statistical analysis; SG wrote the article in collaboration with CLV; all other authors gave substantial contributions to conception, design and interpretation of data; all the authors approved the final version of the manuscript.

Funding The project 'Pricing Policies and Control of Tobacco in Europe (PPACTE)' was partly funded by the European Commission Seventh Framework Programme Grant Agreement HEALTH-F2-2009-223323. The work of Gallus, Lugo and La Vecchia is partially supported by the Italian Association for Cancer Research (AIRC, No. 10068) and the Italian League Against Cancer (LILT), Milan. The work of Fernández is partially supported by the the Instituto de Salud Carlos III of Spain (grants RTICC RD06/0020/0089 and RD12/0036/0053) and the Ministry of Universities and Research of Catalonia (grant 2009SGR192).

Competing interests None.

What this study adds

* Using data from one of the few European studies on smoking in adults allowing for between-country comparisons, we found that more than 1 out of 4 Europeans were current smokers in 2010.

* We observed substantial differences across 18 European countries in terms of smoking prevalence, and male-to-female and current-to-ex smoking prevalence ratios, suggesting that various countries are at different stages of the tobacco epidemic.

* The level of education was inversely related to smoking prevalence, not only in men but also in women.

* Lower income countries and those with less strict tobacco control activities, mainly from Eastern Europe, had less favourable smoking patterns.

REFERENCES

[1] WHO. WHO Framework Convention on Tobacco Control. Geneva, Switzerland: World Health Organization 2003. Available online at: http://whqlibdoc.who.int/publications/2003/9241591013.pdf; last access 13 March 2013.

[2] Bogdanovica I, Godfrey F, McNeill A, et al. Smoking prevalence in the European Union: a comparison of national and transnational prevalence survey methods and results. Tob Control 2011;20:e4.

[3] WHO. WHO: European Health For All Database (HFA-DB). Geneva, Switzerland: World Health Organization 2012. Available online at: http://www.euro.who.int/en/what-we-do/data-and-evidence/databases/european-health-for-all-database-hfa-db2; last access 13 March 2013.

[4] Gallus S, Tramacere I, Boffetta P, et al. Temporal changes of under-reporting of cigarette consumption in population-based studies. Tob Control 2011;20:34-9.

[5] Pirkis JE, Irwin CE, Jr., Brindis C, et al. Adolescent substance use: beware of international comparisons. J Adolesc Health 2003;33:279-86.

[6] Schaap MM, Kunst AE, Leinsalu M, et al. Female ever-smoking, education, emancipation and economic development in 19 European countries. Soc Sci Med 2009;68:1271-8.

[7] Agyemang C, Stronks K, Tromp N, et al. A cross-national comparative study of smoking prevalence and cessation between English and Dutch South Asian and African origin populations: the role of national context. Nicotine Tob Res 2010;12:557-66.

[8] Gilmore A, Pomerleau J, McKee M, et al. Prevalence of smoking in 8 countries of the former Soviet Union: results from the living conditions, lifestyles and health study. Am J Public Health 2004;94:2177-87.

[9] Pomerleau J, Gilmore A, McKee M, et al. Determinants of smoking in eight countries of the former Soviet Union: results from the living conditions, lifestyles and health study. Addiction 2004;99:1577-85.

[10] Thyrian JR, Panagiotakos DB, Polychronopoulos E, et al. The relationship between smokers' motivation to quit and intensity of tobacco control at the

population level: a comparison of five European countries. BMC Public Health 2008;8:2.

[11] Avendano M, Glymour MM, Banks J, et al. Health disadvantage in US adults aged 50 to 74 years: a comparison of the health of rich and poor Americans with that of Europeans. Am J Public Health 2009;99:540-8.

[12] Oh DL, Heck JE, Dresler C, et al. Determinants of smoking initiation among women in five European countries: a cross-sectional survey. BMC Public Health 2010;10:74.

[13] Heck JE, Stucker I, Allwright S, et al. Home and workplace smoking bans in Italy, Ireland, Sweden, France and the Czech Republic. Eur Respir J 2010;35:969-79.

[14] Pampel FC, Denney JT. Cross-national sources of health inequality: education and tobacco use in the world health survey. Demography 2011;48:653-74.

[15] Hosseinpoor AR, Parker LA, Tursan d'Espaignet E, et al. Social determinants of smoking in low- and middle-income countries: results from the world health survey. PLoS One 2011;6:e20331.

[16] WHO. Global Adult Tobacco Survey (GATS). Geneva, Switzerland: World Health Organization 2010. Available online at: http://www.who.int/tobacco/surveillance/survey/gats/en/index.html; last access 13 March 2013.

[17] Eurobarometer. Special Eurobarometer 272c / Wave 66.2. Attitudes of Europeans towards tobacco: Report. 2007. Available online at: http://ec.europa.eu/public_opinion/archives/ebs/ebs_272c_en.pdf; last access 13 March 2013.

[18] Eurobarometer. Special Eurobaroameter 332/ Wave72.3: Tobacco 2010. Available online at http://ec.europa.eu/public_opinion/archives/ebs/ebs_332_en.pdf; last access 13 March 2013.

[19] Eurobarometer. Special Eurobaroameter 385/ Wave EB77.1. Attitudes of Europeans towards tobacco 2012. Available online at: http://ec.europa.eu/health/tobacco/docs/eurobaro_attitudes_towards_tobacco_2012_en.pdf; last access 13 March 2013.

[20] Gallus S, La Vecchia C. Tobacco control: Economic aspects of smoking. Prev Med 2012;55:546-7.

[21] Gallus S, Lugo A, La Vecchia C, et al. PPACTE, WP2: European survey on smoking. Dublin, Ireland: PPACTE consortium 2012. Available online at: http://www.ppacte.eu/index.php?option=com_docman&task=doc_download&gid=185&Itemid=29; last access 13 March 2013.

[22] Currie L, Townsend J, Leon Roux ME, et al. Policy Recommendations for Tobacco Taxation in the European Union. Integrated Research Findings from the PPACTE project. Dublin, Ireland: PPACTE consortium 2012. Available online at: http://www.ppacte.eu/index.php?option=com_docman&task=doc_download&gid=194&Itemid=29; last access 12 March 2013.

[23] Joossens L, Lugo A, La Vecchia C, et al. Illicit cigarettes and hand-rolled tobacco in 18 European countries: a cross-sectional survey. Tob Control 2012. December 10 [Epub ahed of print] doi: 10.1136/tobaccocontrol-2012-050644.

[24] IMF. World Economic Outlook Dabases (WEO), April 2011 2011. Avaliable online at: http://www.imf.org/external/pubs/ft/weo/2011/01/weodata/weoselgr.aspx; last access 13 March 2013.

[25] Joossens L, Raw M. The Tobacco Control Scale 2010 in Europe. Brussels, Belgium: Association of the European Cancer Leagues 2011. Available online at: http://www.krebshilfe.de/fileadmin/Inhalte/Downloads/PDFs/Kampagnen/TCS_2010_Europe.pdf; last access 13 March 2013.

[26] EUROSTAT. Demography-National data: Population on 1 January 2010. Available online at: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database; last access 13 March 2013.

[27] Gallus S, Schiaffino A, La Vecchia C, et al. Price and cigarette consumption in Europe. Tob Control 2006;15:114-9.

[28] Lopez A, Collishaw N, Piha T. A descriptive model of the cigarette epidemic in developed countries. Tobacco Control 1994;3:242-7.

[29] Thun M, Peto R, Boreham J, et al. Stages of the cigarette epidemic on entering its second century. Tob Control 2012;21:96-101.

[30] La Vecchia C, Decarli A, Pagano R. Patterns of smoking initiation in Italian males and females from 1955 to 1985. Prev Med 1995;24:293-6.

[31] Tramacere I, Gallus S, Pacifici R, et al. Smoking in young and adult population, Italy 2009. Tumori 2011;97:423-7.

[32] Kaleta D, Makowiec-Dabrowska T, Dziankowska-Zaborszczyk E, et al. Prevalence and socio-demographic correlates of daily cigarette smoking in Poland: results from the Global Adult Tobacco Survey (2009-2010). Int J Occup Med Environ Health 2012;25:126-36.

[33] Huisman M, Kunst AE, Mackenbach JP. Inequalities in the prevalence of smoking in the European Union: comparing education and income. Prev Med 2005;40:756-64.

[34] Schiller JS, Lucas JW, Ward BW, et al. Summary health statistics for U.S. adults: National Health Interview Survey, 2010. Vital Health Stat 10 2012:1-207.

[35] Martinez-Sanchez JM, Fernandez E, Fu M, et al. Smoking behaviour, involuntary smoking, attitudes towards smoke-free legislations, and tobacco control activities in the European Union. PLoS One 2010;5:e13881.

[36] IARC. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Vol 100E; pages 43-170. Lyon, France: IARC 2012. Available online at: http://monographs.iarc.fr/ENG/Monographs/vol100E/mono100E-6.pdf; last access 12 March 2013.

[37] Bosetti C, Malvezzi M, Rosso T, et al. Lung cancer mortality in European women: Trends and predictions. Lung Cancer 2012;78:171-8.

[38] La Vecchia C, Bosetti C, Lucchini F, et al. Cancer mortality in Europe, 2000-2004, and an overview of trends since 1975. Ann Oncol 2010;21:1323-60.

Legend to Figures

Figure 1 European countries included in the European survey. The colours indicate the proportion of current cigarette smokers in men and women combined (green= relatively low, yellow=intermediate and red=relatively high). Numbers represent overall smoking prevalence estimates (%). PPACTE, 2010.

Table 1 Sample size, age range and other information about CAPI survey methods in 18 European countries. PPACTE, 2010.

Country	Initial	Fieldwork dates		Achieved sample size	Age range (years)	Sampling method*
		start	end			
Albania	AL	01/07/2010	18/07/2010	1000	15-80	Multi-stage random sampling
Austria	AT	14/06/2010	09/07/2010	1001	≥15	Quota method
Bulgaria	BG	20/05/2010	08/06/2010	1027	≥15	Stratified random sampling
Croatia	HR	01/07/2010	15/07/2010	948	≥18	Multi-stage random sampling
Czech Republic	CZ	29/03/2010	11/04/2010	1000	≥15	Stratified random sampling with quota support
England	UK	03/06/2010	08/06/2010	1030	≥18	Quota method
Finland	FI	13/04/2010	23/04/2010	962	18-79	Quota method
France	FR	27/05/2010	31/05/2010	1029	≥15	Quota method
Greece	GR	07/06/2010	27/06/2010	965	18-64	Simple random sampling
Hungary	HU	10/05/2010	04/06/2010	1002	≥18	Multi-stage random sampling
Ireland	IE	05/06/2010	16/06/2010	1008	≥15	Quota method
Italy	IT	15/01/2010	30/01/2010	1005	≥15	Multi-stage random sampling
Latvia	LV	04/06/2010	18/06/2010	1061	15-74	Stratified random sampling
Poland	PL	14/06/2010	17/06/2010	938	18-79	Multi-stage random sampling
Portugal	PT	01/06/2010	29/06/2010	1000	≥15	Not available
Romania	RO	10/06/2010	16/06/2010	1080	≥15	Multi-stage random sampling
Spain	ES	07/07/2010	14/07/2010	1000	≥15	Random route with quota sampling
Sweden	SE	06/06/2010	09/06/2010	1000	≥15	Cluster sampling
Total	TOT	15/01/2010	18/07/2010	18,056	≥15	

*Further details on the sampling methods are available elsewhere[21]

Table 2 Country-specific prevalence of current smokers (%) in the European population aged 15 years or over, overall and by sex, male-to-female smoking prevalence ratio (M/F) and current-to-ex smoking prevalence ratio (C/E). PPACTE, 2010.

	N	Smoking prevalence (%)			M/F	C/E
		Total	Men	Women		
Total*	18,056	27.2	30.6	24.1	1.27	1.70
Country						
Albania	1000	26.1	40.2	11.6	3.47	4.28
Austria	1001	30.4	37.6	23.9	1.57	1.97
Bulgaria	1027	40.9	44.3	37.7	1.18	2.66
Croatia	948	26.6	31.3	22.5	1.39	1.83
Czech Republic	1000	29.1	35.9	22.6	1.59	2.40
England	1030	24.9	26.5	23.3	1.14	1.03
Finland	962	26.3	33.9	18.8	1.80	0.96
France	1029	27.5	30.9	24.4	1.27	1.34
Greece	965	38.9	43.7	34.0	1.29	3.38
Hungary	1002	35.5	42.7	28.6	1.49	3.87
Ireland	1008	36.0	33.9	38.1	0.89	2.14
Italy	1005	22.0	25.8	18.5	1.39	2.07
Latvia	1061	28.8	42.9	16.3	2.63	2.03
Poland	938	28.0	33.0	23.1	1.43	3.43
Portugal	1000	32.4	35.7	29.4	1.21	2.13
Romania	1080	26.1	34.9	17.7	1.97	2.18
Spain	1000	28.6	26.2	31.0	0.85	1.55
Sweden	1000	16.3	15.7	17.0	0.92	0.68

*Prevalence estimates for the overall population were computed weighting each country in proportion to the country specific population aged 15 years or over.

Table 3 Prevalence* of current smokers (%) in the European population aged 15 years or over, overall and by sex, male-to-female smoking prevalence ratio (M/F) and current-to-ex smoking prevalence ratio (C/E), according to selected individual-level and country specific characteristics. PPACTE, 2010.

	N	Smoking prevalence (%)			M/F	C/E
		Total	Men	Women		
Individual-level characteristics						
Age group (years)						
<25	2860	26.5	26.0	27.0	0.96	5.10
25-44	6423	35.9	39.8	32.0	1.24	3.06
45-64	5702	27.2	30.5	24.0	1.27	1.27
≥65	3071	11.5	15.3	8.6	1.78	0.49
Education^						
Low	5795	26.1	31.4	20.9	1.50	1.62
Intermediate	8289	29.6	31.5	27.8	1.13	1.89
High	3968	24.6	26.9	22.3	1.21	1.48
Country specific characteristics†						
Geographic area						
Northern Europe	4000	24.5	26.0	23.1	1.13	1.03
Western Europe	2030	27.9	31.7	24.4	1.30	1.40
Southern Europe	3970	26.7	28.4	25.1	1.13	1.93
Eastern and Central Europe	8056	29.4	36.0	23.1	1.56	2.80
Per capita Gross Domestic Product (GDP) adjusted for Purchasing Power Parity (PPP)						
<16,000 €	7056	29.4	36.0	23.1	1.56	2.86
≥16,000 €	11,000	26.6	28.9	24.3	1.19	1.49
Tobacco Control Scale (TCS; score)‡						
<45	7994	31.8	37.3	26.6	1.40	2.85
≥45	8114	25.5	27.9	23.2	1.20	1.42

*Prevalence estimates were computed weighting each country in proportion to the country specific population aged 15 years or over.
^The sum does not add up to the total because of some missing values.
†Classification of countries. Northern Europe: FI, IE, SE, UK; Western Europe: AT, FR; Southern Europe: ES, GR, IT, PT; Eastern and Central Europe: AL, BG, CZ, HR, HU, LV, PL, RO. Per capita GDP adjusted for PPP <16,000€: AL, BG, HR, HU, LV, PL, RO; per capita GDP adjusted

for PPP ≥16,000€: AT, CZ, ES, FI, FR, GR, IE, IT, PT, SE, UK. TCS<45: AT, BG, CZ, GR, HU, LV, PL, PT; TCS ≥45: ES, FI, FR, IE, IT, RO, SE, UK.
‡Albania and Croatia were excluded.

Table 4 Odds ratios (OR) for current smokers *vs.* non-smokers (never and ex-smokers combined) and corresponding 95% confidence intervals (CI) according to selected individual-level and country specific characteristics, overall and by sex. PPACTE, 2010.

	OR* for current *vs* non smokers (95% CI)		
	TOTAL	MEN	WOMEN
Individual-level characteristics			
Sex			
Men	1^	-	-
Women	0.73 (0.68-0.78)	-	-
Age group (years)			
<25	1^	1^	1^
25-44	1.65 (1.49-1.83)	2.03 (1.75-2.34)	1.32 (1.14-1.53)
45-64	1.05 (0.95-1.17)	1.28 (1.10-1.49)	0.86 (0.74-1.01)
≥65	0.37 (0.32-0.43)	0.52 (0.43-0.63)	0.26 (0.21-0.32)
P for trend	<0.001	<0.001	<0.001
Education			
Low	1.50 (1.35-1.66)	1.62 (1.40-1.86)	1.37 (1.18-1.70)
Intermediate	1.43 (1.30-1.57)	1.41 (1.23-1.61)	1.48 (1.29-1.59)
High	1^	1^	1^
P for trend	<0.001	<0.001	0.001
Country specific characteristics†			
Geographic area			
Northern Europe	1^	1^	1^
Western Europe	1.16 (1.04-1.30)	1.27 (1.08-1.48)	1.07 (0.91-1.26)
Southern Europe	1.05 (0.95-1.16)	1.04 (0.91-1.19)	1.08 (0.93-1.24)
Eastern Europe	1.18 (1.06-1.31)	1.46 (1.27-1.69)	0.92 (0.79-1.07)
Per capita Gross Domestic Product (GDP) adjusted for Purchasing Power Parity (PPP)			
<16,000€	1.08 (1.00-1.16)	1.30 (1.17-1.45)	0.86 (0.77-0.97)
≥16,000€	1^	1^	1^
Tobacco Control Scale (TCS; score)			
<45	1.27 (1.18-1.37)	1.44 (1.30-1.60)	1.10 (0.98-1.22)
≥45	1^	1^	1^

*OR for individual-level characteristics were estimated using multilevel (two-levels) logistic random effects models (random intercept) The study country effects were considered as random, and age and level of education as adjusting variables. ORs for country specific characteristics were estimated by unconditional multiple logistic regression models, including terms for age and level of education. ORs for the overall population were further adjusted for sex. Estimates were weighted for statistical weights that consider country specific population.

^Reference category.

†Classification of countries. Northern Europe: FI, IE, SE, UK; Western Europe: AT, FR; Southern Europe: ES, GR, IT, PT; Eastern and Central Europe: AL, BG, CZ, HR, HU, LV, PL, RO. Per capita GDP adjusted for PPP <16,000€: AL, BG, HR, HU, LV, PL, RO; per capita GDP adjusted for PPP ≥16,000€: AT, CZ, ES, FI, FR, GR, IE, IT, PT, SE, UK. TCS<45: AT, BG, CZ, GR, HU, LV, PL, PT; TCS ≥45: ES, FI, FR, IE, IT, RO, SE, UK.